

Processing Services in Earth Observation  
Sensor Web Information Architectures:  
*Using Sensor Webs for Air Quality Science and Applications  
Today, Tomorrow and Yesterday*

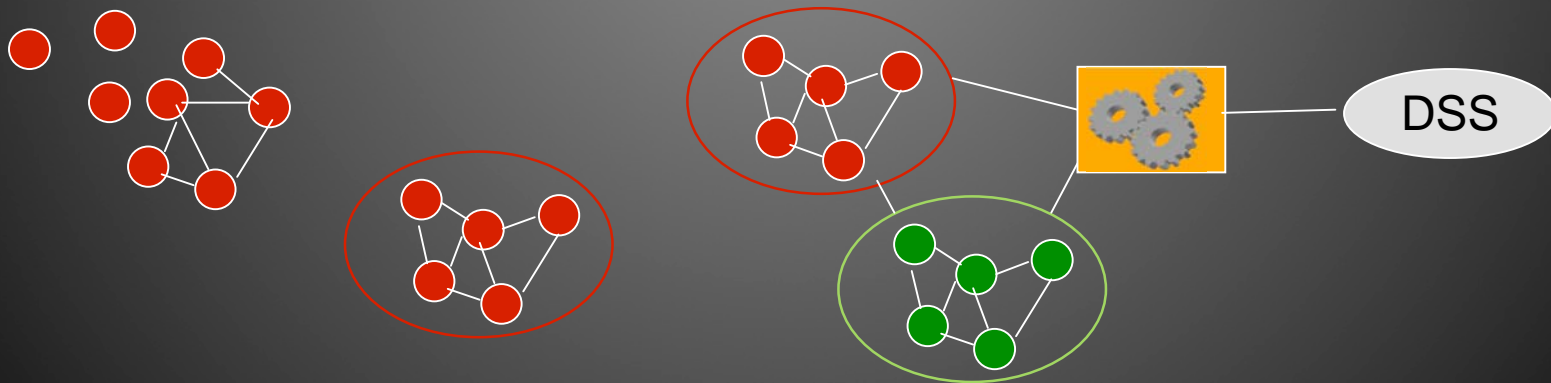
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# Application of Sensor Observations

- Sensors and sensor networks gain value from the use of their observations
- How to best get data and information out of sensor networks and integrated with other sensor data, models, and ultimately decision support systems?
- Need a framework that is flexible and expandable (new sensors, models, tools need to be accommodated)

**Sensors -> Sensor Networks -> Sensor Webs -> Decision Making**



# Data Processing in Sensor Webs

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- Sensor Web R&D has focused on accessing and visualizing sensor data
- New research being done on processing services and service workflows in standards-based Service Oriented Architectures
- Types of data processing:
  - Deriving data products (e.g. from “raw” data to information product)
  - Filtering, aggregation or fusion (e.g., subsetting, averaging)
  - Analysis (e.g., spatial patterns, temporal trends)
  - Forecast modeling (e.g., estimating conditions 1-3 days in future)

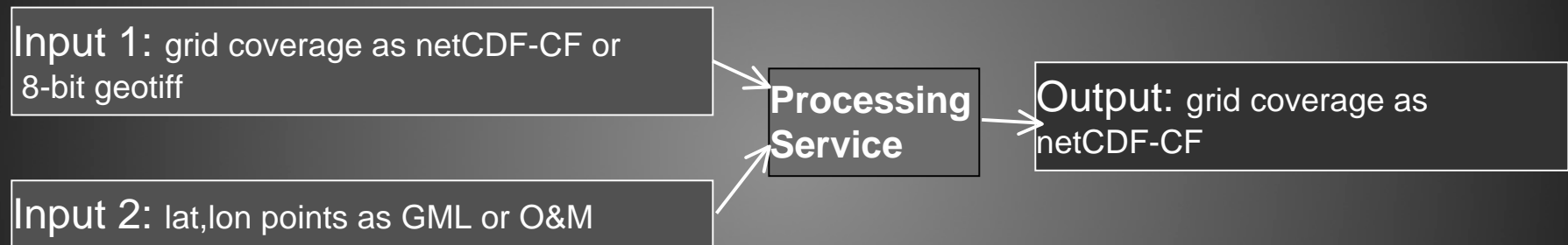
# Sensor Web Processing Services

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- Sensor observation processing occurs during multiple stages:
  - On sensor platform (to reduce data size that needs to be sent to ground)
  - On sensor data service server (to reduce data size that needs to be accessed across the network)
  - On data processing server (as part of a distributed network where data access and data processing occur on separate nodes)
- Approaches to processing services
  - Open Geospatial Consortium Web Processing Service (OGC WPS)
  - Web Service Description Language (WSDL)
  - Workflow Chaining for Web Services (WfCS)
  - Earth Science Modeling Framework (ESMF)
  - Other workflow modeling languages (BPEL, Kepler, ...)
  - and others...

# General Characteristics of a Processing Service

- Description of process (algorithm)
- How to access and execute the process
- Inputs (data and service settings/options)
- Outputs (output types, data formats)



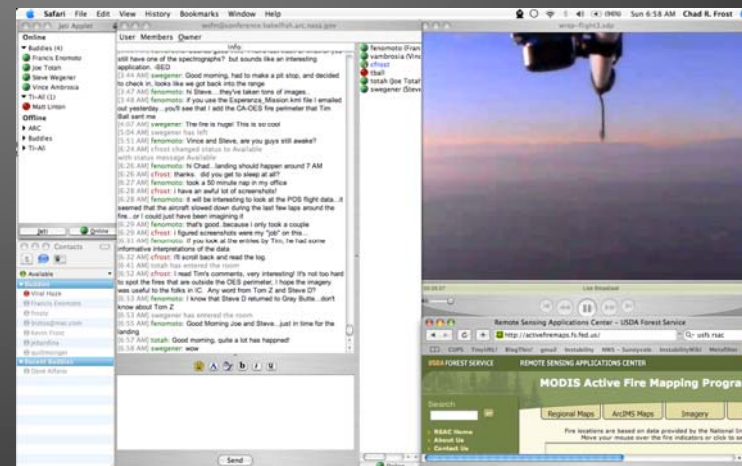
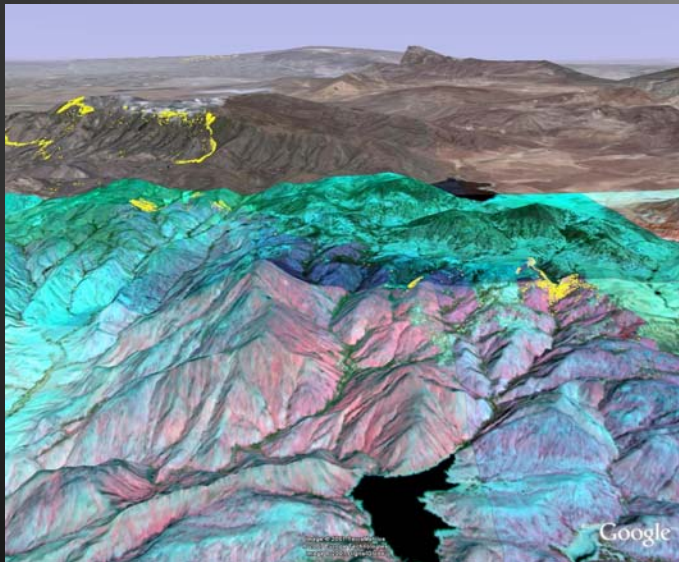
- Processing services tend not to be stand-alone services. They inherently are part of a workflow with inputs from “upstream” services and outputs used by “downstream” services
- The interfaces are standardized for describing the above properties but the implementation of the algorithm for processing is specific to the processing service provider



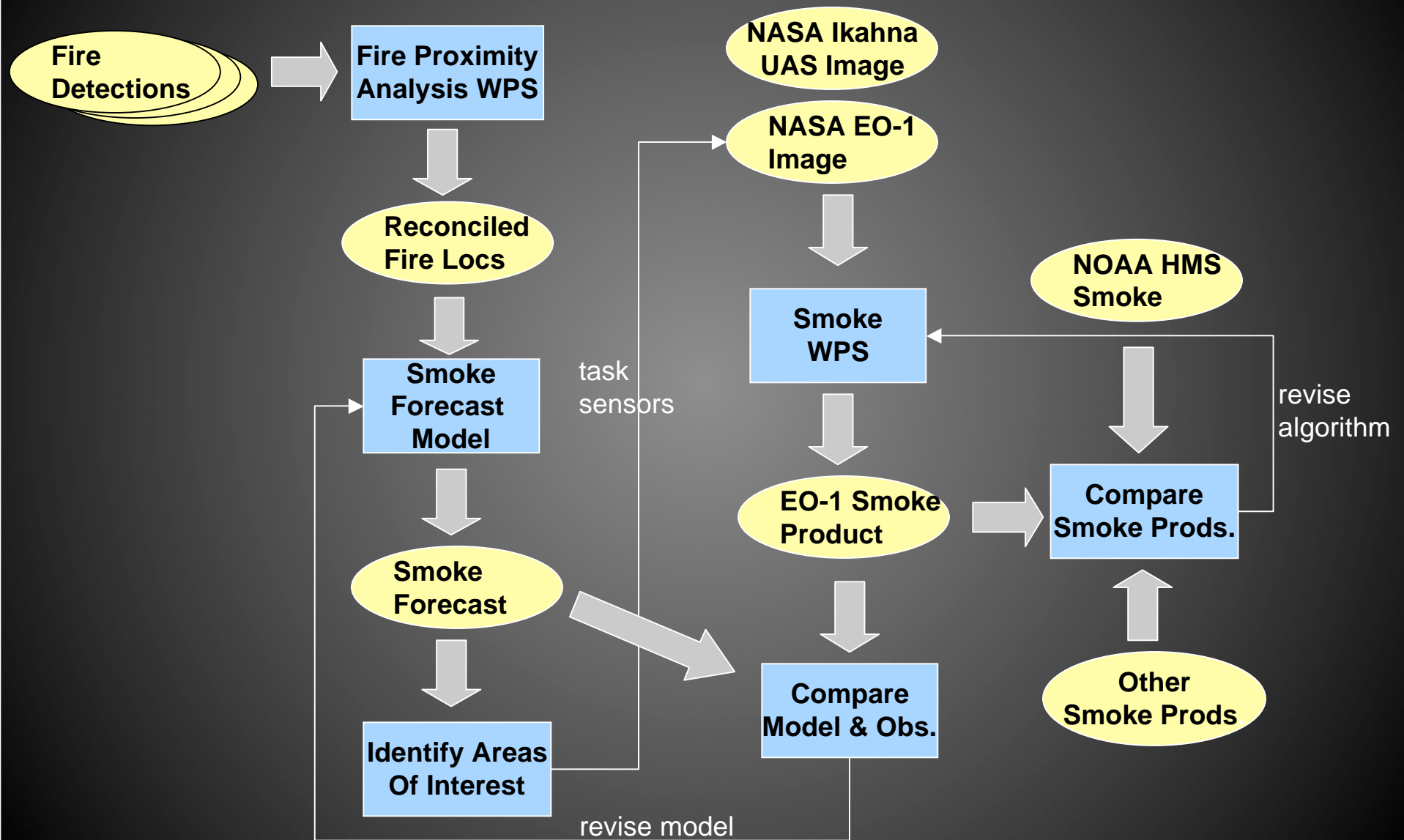
# Sensor Webs in Wildfire and Smoke Applications

Sensor networks of surface, aerial, and surface sensors provide timely data for:

- Identifying fire location, fire progression, smoke coverage
- Forecasting fire behavior, smoke dispersion, and air quality
- Retasking sensors for making new measurements
- Retrospective analysis and assessment
- Validating forecast models
- Issuing public health alerts

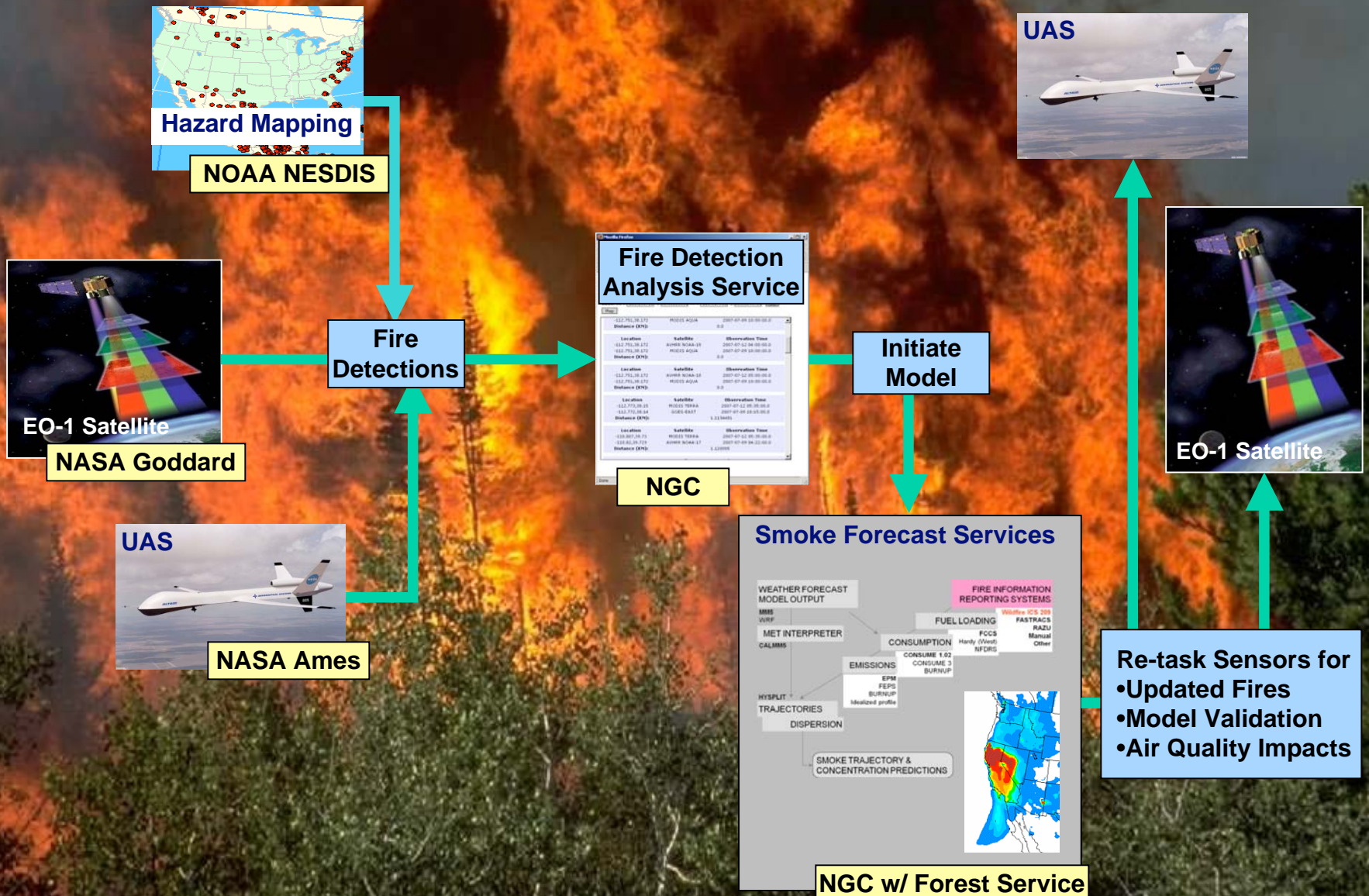


# Processing Services for Wildfire and Smoke Applications





# ESTO Wildfire Scenario Demonstrations (Mandl, et al)

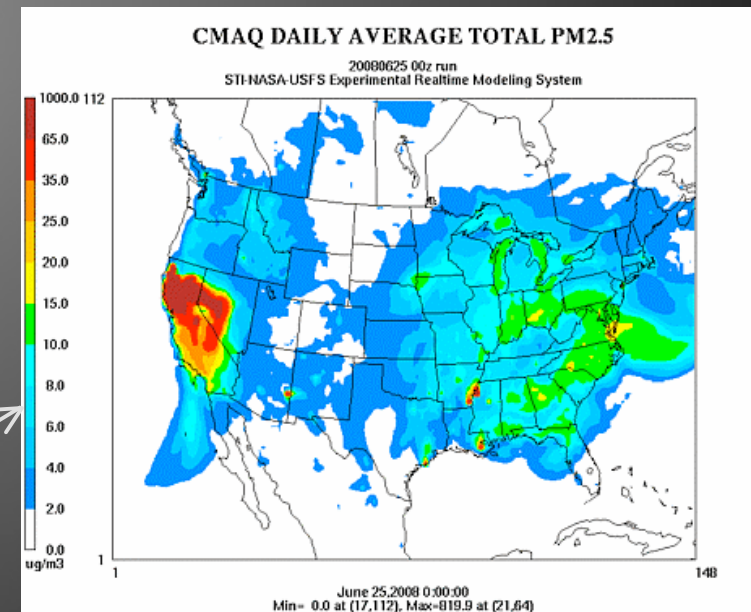
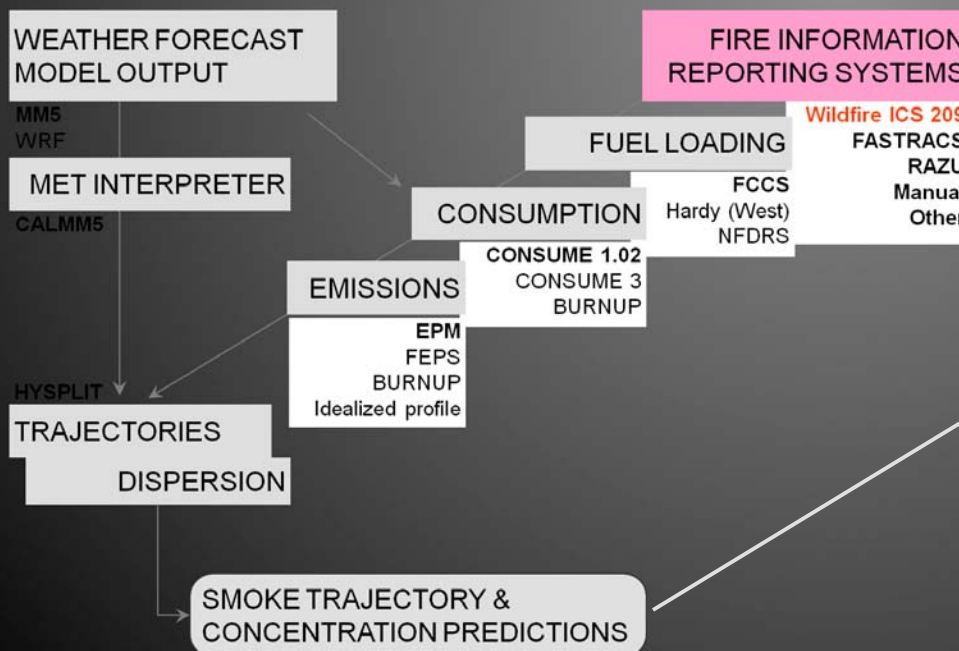




# Bluesky Gateway

An open-source modeling framework that offers an architecture for multiple and varied models to communicate with each other in a modular, user-driven environment to simulate cumulative smoke impacts, air quality, and emissions from forest, agricultural, and range fires. It combines state-of-the-science emissions, meteorological, and dispersion models to generate results based on the best available models.

We are working to integrate the modeling framework, through standard web processing service interfaces, with sensor web systems.



<http://getbluesky.org/>

# GEOSS Architecture Implementation Pilot

The Global Earth Observation System of Systems (**GEOSS**) aims to help realize a future wherein decisions and actions for the benefit of humankind are informed via coordinated, comprehensive and sustained Earth observations and information among countries.

GEOSS includes an information infrastructure supporting the exchange of observations recorded from in situ, aircraft, and satellite networks, in a full and open manner with minimum time delay and minimum cost

The GEOSS Architecture Implementation Pilot addresses the processes needed for an interoperable framework and network of earth observation information services.



# GEOSS AI Pilot Air Quality Scenario

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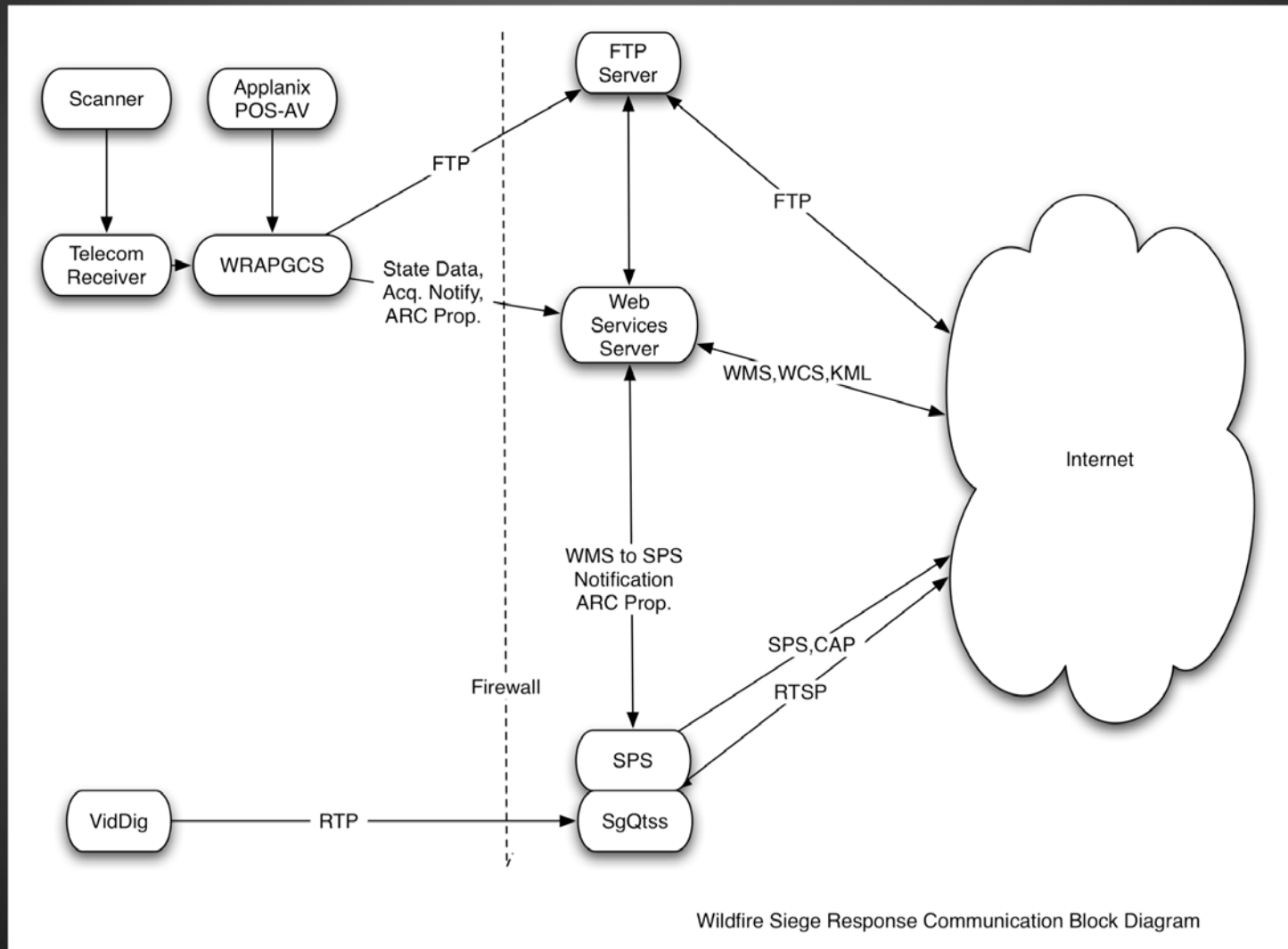
## Web Processing Functionality Needed

- **Integration of multiple observational data** sets to create rich multi-dimensional descriptions of the atmosphere
- **Comparison of observational data with numerical model estimates** to improve numerical models
- **Real-time assimilation** of observational data into numerical models to improve numerical forecasts

## Target Audience

- **A policy-maker**, needing synthesized information on the importance of intercontinental pollutant transport of pollution plumes
- **An air quality manager**, who needs to assess whether a regional pollution event was caused by an "exceptional event," such as a smoke from a wildfire
- **The public**, needing information about air quality now and in the near future (via forecasts) to make activity decisions

# Ikhana Web Service Flow





# California Smoke Today, 26 June 2008

